

First record of association of planktonic diatom *Chaetoceros coarctatus* Lauder, 1864 with a peritrich ciliate epibiont *Vorticella oceanica* Zacharias, 1906 (Ciliophora: Peritricha) from the Indian Ocean region

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Vorticella oceanica Zacharias, 1906¹, a peritrich ciliate was found on the marine planktonic diatom *Chaetoceros coarctatus* Lauder, 1864² from the coastal waters of southwestern Bay of Bengal. The present report can be considered as the first report of the epibiont *Vorticella oceanica* from the Indian coastal water as well as from Indian Ocean.

[**Keywords:** Epibiont, *Chaetoceros coarctatus*, *Vorticella oceanica*, Diatom, Ciliate, Indian Ocean]

Introduction

Chaetoceros Ehrenberg, 1844 was first identified from Antarctic Ocean specimens. The worldwide distribution of this genus often dominates the marine diatom population³⁻⁵. Although ~400 species are found worldwide under this genus^{4 & 6}, work by Ferrario et al.,⁷ explained ~ 175 species in this genus.

The genus *Chaetoceros* is found to be well diversified in Indian coastal waters as well as in Indian Ocean region, by representing ~ 30-35 species. Among these species of *Chaetoceros*, some of the very common species in the Indian waters are *Chaetoceros lorenzianus*, *C. decipiens*, *C. coarctatus*, *C. compressus*, *C. messanensis*, *C. contortus* etc. Among these *Chaetoceros* species some of the species have association with different ciliates as epibionts, as in the present study many *Chaetoceros coarctatus* chains were found to be associated with the peritrich ciliate *Vorticella oceanica*. The present

study was carried out in the coastal waters of Kalpakkam, southwestern Bay of Bengal (SW-BOB), east coast of India.

Most of the organism associations found from Indian waters are either between ciliate protozoans (as epibiont) and copepods/ other crustaceans (as host) or between photosynthetic micro-organisms (as epibiont) and copepods (as host). However, ciliate protozoan epibiont in association with marine planktonic diatoms was found from this coast, which to the best of our knowledge is the first report from the Indian waters as well as Indian Ocean. Among different ciliate protozoan epibionts, *Vorticella oceanica* is one of the important one and was confirmed from our sample by detailed morphological investigations by the help of previous literature⁸. Though, this study on the epibiont was not carried out with an objective, we observed this phenomenon during our routine phytoplankton monitoring program.

Materials and Methods

Samples were collected from the coastal waters of Kalpakkam (~500m away from seashore inside the sea), SW-BOB. Phytoplankton samples were collected using plankton nets of 55 µm mesh size. After collection, phytoplankton samples were preserved with 1% Lugol's Iodine solution (for staining and preserving) and 5% buffered formalin (to avoid the interference of zooplankton in phytoplankton analysis). Preserved samples were transferred to laboratory for qualitative and quantitative analyses. Each sample was screened under stereo binocular microscope (Zeiss Axiovert 40 CFL). Phytoplanktons were identified up to species level using standard literature⁹⁻¹¹. Our samples yielded a good number of *C. coarctatus* with attached *Vorticella* ciliates as epibiont and were photographed individually *in vivo* under the light microscope. Permanent slides were prepared using DPX (Refractive index = 1.52) as a mounting medium. Specimens were measured and photographed under Zeiss Axio Observer A1 microscope with Jenoptik ProgRes CF Scan Camera and CapturePro image analysis software.

Results and Discussion

Phytoplankton samples collected from the coastal waters of SW-BOB constituted ~7-10% of *Chaetoceros* spp. (in surface water). Except *Chaetoceros coarctatus*, other species were not observed with epibionts. As *Chaetoceros coarctatus* was classified as an oceanic warm water species^{8,12}, it was found in moderate density in our coastal water samples.

Taxonomic remarks of *Chaetoceros coarctatus*

Chaetoceros coarctatus forms straight chains attached to *Vorticella* species¹³. The diatom has two terminal setae forms, based on the chain position, shape and direction. The setae on the anterior valve are "anterior terminal setae, and on the posterior valve are "posterior terminal setae"^{14 & 15}. The anterior terminal setae are less robust than posterior one and interestingly, the special intercalary setae possess longer and robust spines compared to other setae found in other species of this genus.

Classification

Class: BACILLARIOPHYCEAE **Haeckel 1878**

Order: CENTRALES **Hustedt 1930**

Sub-order: BIDDULPHIINEAE **Simonsen 1872**

Family: CHAETOCERACEAE **Smith 1872**

Genus: *Chaetoceros* **Ehrenberg 1844**

Species: *coarctatus* **Lauder 1864**

The peritrich ciliate epibiont *Vorticella oceanica* was first described by Zacharias in 1906¹ from Sargasso Sea, where they found it attached to *Chaetoceros*⁸. According to Nagasawa & Warren⁸, Zacharias¹ did not provide the diagram for *V. oceanica*, but he explained the bell dimension (28 µm long, 22 µm diam. with oral cilia 12 µm in length). In 1943, Cupp¹³ provided the diagram for *V. oceanica* and the dimensions almost matched with that of Zacharias's¹ description.

Classification

Kingdom: PROTISTA **Ernst Haeckel, 1886**

Phylum: CILIOPHORA **Doflein, 1901**

Class: OLIGOHYMENOPHOREA de Puytorac *et al.*, 1974

Sub-class: PERITRICHIA **Stein, 1859**

Order: SESSILIDA **Kahl, 1933**

Family: VORTICELLIDAE **Ehrenberg, 1838**

Genus: *Vorticella* **Linnaeus, 1767**

Species: *oceanica* **Zacharias, 1906**

Vorticella oceanica was conspecific with *V. striata* Dujardin, 1841¹⁶ according to Noland and Finley¹⁷ and Warren¹⁸. Later it was redescribed as a separate species by Nagasawa and Warren⁸.

Morphology

Body conical to bell-shaped. Peristomial disc flat. Pellicle with 25-34 closely spaced striations. One macronucleus vermiform and J-shaped, sometimes elongate bean-shaped. One micronucleus. Single contractile vacuole at ventral wall of vestibulum. Mostly epibiotic on the diatom *Chaetoceros coarctatus*. Size of zooid 18-34 x 22-44 µm. Stalk about 80-200 µm long, distally widened (3-5 µm across).

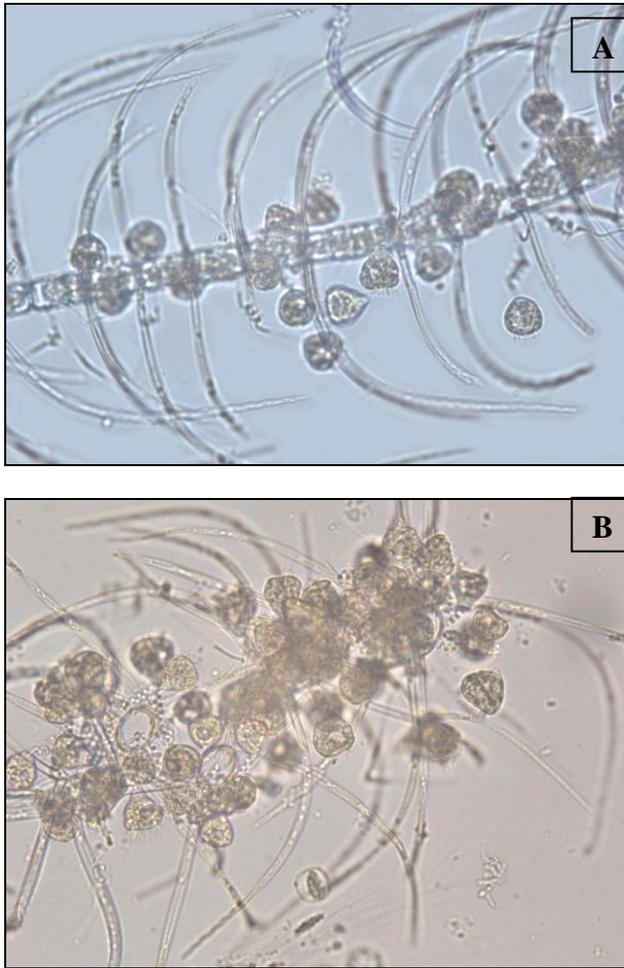


Fig.1 (A-B): Photographs of ciliate epibiont *Vorticella oceanica* showing attachment throughout the chain of diatom *Chaetoceros coarctatus* cells



Fig. 2: Photograph of a single cell of *Vorticella oceanica*

Distribution and host specificity

Reports on the relationship between *V. oceanica* and *C. coarctatus* (Fig.1 & 2) indicated that the relation is either epibiosis or phoresis⁸. According to Lincoln *et al.*¹⁹ ‘Epibiosis’ is a symbiotic relationship in which one organism gets attached to the outer surface of another organism. And Kinne²⁰ described the phenomenon of phoresis as the provision of shelter, transportation and other facilities to one organism by another one without any effect on metabolic activity. According to Herman & Mihursky²¹ and Nagasawa^{22 & 23} phoresis seems to be species specific. *Vorticella oceanica* has been found earlier from Sargasso Sea¹, off the Pacific coast of North America¹³, off the Pacific coast of Japan^{24 & 25}, off the western African coast of Sierra Leone²⁶, from the Caribbean Sea²⁷ and off the coast of Amami-Oshima Island, Japan²⁸.

This is evident from the earlier studies that solely *V. oceanica* is recorded as an epibiont of *C. coarctatus*^{13, 24, 25, 27-29}. There is a single report of *V. oceanica* in association with another basibiont (host-*Chaetoceros tetrastichon*) other than *C. coarctatus*²⁶. However, later with ample of evidences the host was confirmed as *C. coarctatus*, which was misidentified as *Chaetoceros tetrasticho*²⁶.

Remarks

Although *Chaetoceros coarctatus* is an oceanic warm water species, it was observed in the coastal waters of SW-BOB in a few occasions with good numbers during the present study, with epibiont *V. oceanica*. The epibiont *V. oceanica* was found attached to the whole length of the host *C. coarctatus*. This could be attributed to the specialized cell and setae structure of *C. coarctatus*, which attract the Vorticellids to attach on it.

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